SCIENCE

VOL. 90 FRIDAY, JULY 28, 1939 No. 2326

Dedication of the William Albert Noyes Laboratory of Chemistry at the University of Illinois: PROFESSOR ROGER ADAMS; PROFESSOR WILLIAM A. NOYES 71

Obituary:

Joseph Grinnell: PROFESSOR WM. E. RITTER. *Recent Deaths and Memorials* 75

Scientific Events:

Transfer of the Bureau of Fisheries; Reorganization of the Work in Zoology at Cornell University; Grants of the National Tuberculosis Association; Guggenheim Fellowships for Brazil, Canada, Peru and Uruguay; American Ornithologists' Union 76

Scientific Notes and News 79

Discussion:

Present-day Botany in Italy: PROFESSOR FRANCIS RAMALEY. *The Production of Unfertilized Seeds in Trillium:* PROFESSOR EDWARD C. JEFFREY and EDWIN J. HAERTL. *The Role of Arrhenotoky in the Adaptation of Insects:* DR. STANLEY E. FLANDERS. *Mottled Enamel in Rat Molars:* DR. GERALD J. COX and OTHERS 81

Quotations:

The British Association for the Advancement of Science 83

Scientific Books:

Popularization of Modern Science: PROFESSOR CHAUNCEY D. LEAKE 84

Reports:

Astronomical Symposium on Galactic and Extragalactic Structure: PROFESSOR OTTO STRUVE 85

Special Articles:

Linkage of Pea Comb and Blue Egg in the Fowl: DR. J. H. BRUCKNER and PROFESSOR F. B. HUTT. *Role of Vitamin E in the Prevention of Muscular Dystrophy in Guinea Pigs:* NOBUKO SHIMOTORI, GLADYS A. EMERSON and DR. HERBERT M. EVANS. *A Quantitative Study of Meaning by a Conditioned Salivary Technique:* DR. G. H. S. RAZRAN. *The Gelatin of Brom Phenol Blue:* DR. EDWARD S. AMIS and PROFESSOR VICTOR K. LA MER 88

Scientific Apparatus and Laboratory Methods:

A Practical Method of Obtaining Bacteria-free Cultures of Trichomonas hominis: DR. WILLIAM S. STONE and MAJOR FRANÇOIS H. K. REYNOLDS. *The Use of the Horsley-Clarke Instrument on the Rat:* DR. GEORGE CLARK 91

Science News 6

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

DEDICATION OF THE WILLIAM ALBERT NOYES LABORATORY OF CHEMISTRY AT THE UNIVERSITY OF ILLINOIS

By Professor ROGER ADAMS

HEAD OF THE DEPARTMENT OF CHEMISTEY, UNIVERSITY OF ILLINOIS

OUR meeting to-day is to honor Dr. William Albert Noyes, formerly head of this department. This is a rather unusual occasion; first, because there is probably a larger proportion of the graduate students and faculty in chemistry gathered here to-day in a group than at any time since I have been associated with the department, and second, because we are naming a building, one half of which is thirty-seven years old and the other half twenty-three years old.

The older members of the staff know Dr. Noyes and his accomplishments. The younger men who are so busily engaged in their studies toward advanced degrees know too little of him. I shall, therefore, outline briefly his career.

Dr. Noyes was born in Iowa and took his undergraduate degree at Grinnell College in 1879. He then went to Johns Hopkins for graduate work. In those days Johns Hopkins was the leading institution for graduate work in chemistry in the country. There he studied under Professor Remsen, whose name is known to all of you, and received the doctor's degree in 1882. His first scientific publication with Professor Remsen appeared that year.

Dr. Noyes served as instructor at the University of Minnesota in 1882–1883 and then accepted a professorship at the University of Tennessee, where he stayed until 1886. The probability is (though I do not have the facts) that at this institution he acted not only as professor of chemistry, but assistant in the laboratory, purchasing agent, janitor and possibly even stenographer as well. In 1887, he became professor at the Rose Polytechnic Institute, where he remained until

1903. The Rose Polytechnic Institute is considered a small school, but before 1900 it was relatively larger in comparison with the other technical schools of that day. During this period Dr. Noyes devoted his time to teaching and research, with facilities inadequate for either. He had a very heavy teaching schedule and in addition was required to do much of the laboratory assisting and other work of the chemistry department usually assigned to others. The necessity of doing all these things would discourage the average individual. Few men, under such circumstances, are able to get ahead and succeed.

During those seventeen years Dr. Noyes not only wrote two text-books but published regularly the results of his investigations in the field of organic, inorganic and analytical chemistry. Because of his accomplishments he became nationally recognized by all American chemists as an outstanding figure. As a consequence, in 1903 he was called to one of the choicest positions in the country as the first chief chemist of the Bureau of Standards, a position which offered opportunity and facilities for scientific research.

The University of Illinois was fortunate in its choice when, in 1907, Dr. Noyes was selected to head the department of chemistry. He continued in that capacity until 1926, when he became *emeritus*.

After this brief survey of the positions he has held I shall speak of some of his specific accomplishments. Dr. Noyes has written two texts and a laboratory manual in inorganic chemistry, a text-book in qualitative analysis, a text and a laboratory manual in organic chemistry. He has likewise completed significant investigations in the three fields of organic, inorganic and analytical chemistry. Few men have combined such a breadth of knowledge.

His researches include the determination of the atomic weight of oxygen, of hydrogen and of chlorine, the values for which were accepted by the Committee on Atomic Weights. The average of the hydrogen-oxygen ratio which he found is essentially the average of all the other values reported by other investigators. In analytical chemistry he developed methods for the determination of phosphorus, of sulfur and manganese in iron. His earlier researches in organic chemistry were on the oxidation of benzene derivatives with potassium ferricyanide and on the structure of camphor. Dr. Noyes was one of the first to recognize the significance of the electron theory and to apply it to ions. His interest in valence and polarity has continued ever since, and much of his research time in the last twenty-five years has been devoted to this field, in which he has made important contributions. Dr. Noyes's ability as a teacher is demonstrated by the prominent men of science trained under his tutelage.

He devoted much of his energy and ability to the American Chemical Society. Not only did he give unsparingly of his time to the formulation of the successful policies of the society, but he did more than any one else in developing the publications of the society. From 1903 to 1907 he was secretary of the society. He was editor of the *Journal of the American Chemical Society* from 1902 to 1917. Because of his successful editorship this journal became one of the leading chemical periodicals of the world. Dr. Noyes played a major role in the establishment of *Chemical Abstracts* and acted as its first editor. The groundwork which he laid resulted in the *Chemical Abstracts* as we know it to-day, the leading abstract journal of the world. His editorial ability led to his being chosen as the first editor of *Chemical Reviews*. Since 1919 he has been editor of *Scientific Monographs* of the American Chemical Society. It would be difficult to find another individual who has contributed as much to the success of the American Chemical Society.

The importance and significance of his accomplishments can best be recognized by the honors he has received from his scientific colleagues. He holds three honorary degrees; he has been the recipient of the Willard Gibbs Medal, the Nichols Medal and the Priestley Medal. This latter is given every three years by the American Chemical Society to a man who has contributed much to American chemistry. He is a member of the three leading honorary societies open to scientists, the American Academy of Arts and Sciences, the American Philosophical Society and the National Academy of Sciences. The American Chemical Society honored him by electing him to its presidency.

In addition to his teaching, editing and scientific work, he has been interested in many other things and has found time for extensive writing. His articles on international affairs, on economics, on peace and on religion are numerous. Many have been printed in foreign languages.

The facts I have given you are, for the most part, a matter of public record. His value to the chemistry department at the University of Illinois can only be known in full by his colleagues and students. He came here in 1907. In the period from 1890 to 1904 the man at the head of the chemistry department was Professor Arthur William Palmer, a scholar and scientist, who understood how chemistry should be taught and who was an investigator at heart. He was severely handicapped, however. With inadequate housing for chemistry and meager funds for supplies and equipment, he was unable to develop the department as he could have done with better support. He did, however, organize the department in such a way that the stage was set for expansion when the opportunity offered. Dr. Noyes, with his resourcefulness, energy, experience and judgment was able to start the department on a rapid and healthy growth. When he arrived in 1907 the senior staff numbered eleven and the gradu-

ate students seventeen. In 1926, when he became emeritus, there was some seven-fold increase in the number of graduate students and the staff had increased to twenty-five. The graduate assistants had trebled or quadrupled in number.

It is pertinent to point out to the younger members of our group the situation of chemistry in the universities from 1900 to 1922. Among university men chemistry was recognized as one of the basic sciences and its importance was not minimized, but in a state institution of the Middle West it is necessary also that it must be so recognized by the general public (and I include legislators as "general public"). In those days the layman looked upon a chemist as an analyst or a dispenser of drugs. Dr. Noyes, with his doggedness, persistence and insistence, was able to convince the administration of the university that it was essential to have increased funds to expand and build a strong department. He recognized also that he must have efficient staff members. Dr. Noyes found a capable group of men in the department when he came here. Among his colleagues were many whose names are familiar to all of you, such as Professor Edward Bartow, now head of the department of chemistry at the State University of Iowa, Dr. A. T. Lincoln, lately retired as head of the department of chemistry at Carleton College, and the late Professor Samuel Wilson Parr.

Dr. Noyes exercised infinite care in the selection of newcomers to his staff. He received the concerted opinion of many individuals before appointing a prospective instructor. He was able to get capable men, and if they left for better positions he sought just as carefully again to find progressive individuals interested in teaching and scholarly work. The administrative and teaching policies of the department were worked out with equal care. As a result, in 1926 when he retired he had a large department which was recognized nationally and internationally.

If I were to close my remarks here, I would omit an important factor in Dr. Noyes's success, his personal characteristics. He has always been absolutely fair; he instilled confidence into his staff members which resulted in a department cooperative and striving for its success. He showed kindliness toward every one, and never lacked time to help and advise a student or staff member.

In closing, let me say that it is a rare individual whom we are honoring to-day. On behalf of the chemistry department, the administration and the trustees of the University of Illinois, I take pleasure in dedicating this building as "The William Albert Noyes Laboratory of Chemistry." We are all happy in the realization that this name will be associated in perpetuity with the chemistry department of the University of Illinois.

RESPONSE BY PROFESSOR NOYES

I THINK I need hardly say how greatly I appreciate the honor which has been bestowed upon me by the university, and especially I appreciate the honor coming from my colleagues of this department and of the university.

In speaking further I thought you might be interested to know something of the background from which I have grown (I suppose I am justified in saying "have grown") to the position which I have held here. I was a country boy born on a farm near Independence, Iowa. One of my early memories as a small boy was that my mother once had lighted a scrap of paper and put it into a wine glass and then clapped the palm of her hand over the glass and showed how, on account of the rarefied air, the glass was held by the pressure of the air to her hand. That was perhaps the earliest physics experiment that I noticed. After that, I became interested especially in physics and chemistry, though with some interest in other sciences as well. A short time after that when my older sisters were reciting their lessons in natural philosophy (we should call it elementary physics), I always stopped and listened, I was so much interested in what they were saying. Then in the years to follow, with the very few advantages I could find in a country farmhouse, with a few additions from the village drug-store, I began to try experiments in physics and chemistry. I read the scientific books not only in those subjects but in others which were available to me, so that I acquired quite a knowledge of these sciences very early in life. I made up my mind while still quite young to go to college, and I learned the elements of Latin from an older sister. Most of my preparation for college, with the exception of three months in Grinnell Academy, was acquired by personal study by myself without a tutor. I learned the Greek alphabet one day while I was cutting corn. I spent in this preparation and later in college four years in the study of Latin and Greek, for the classical course at Iowa College was very much the strongest and best course at that time. I have never regretted the time spent on those languages and the ability to speak which came in that way and in other ways in the years which followed. As I went on the members of the classical course took chemistry in the junior year. When the class went into the laboratory and lecture room of chemistry I went with them, but from that time on, for the last two years at Grinnell, I spent my afternoons in the chemical laboratory studying qualitative and quantitative analysis.

I paid my way through college by going out each winter to teach a district school for three or four months, keeping up my work in college by studying during the evenings so that I completed the work in Grinnell in four years. Not only that, but for the

work in chemistry which I had done, with a little extra study I received at the end of the four years both the A.B. and the B.S. degrees. The following year I taught in the Academy of Iowa College thirty hours a week. In my spare time I did what I think is properly called "graduate work" in the laboratory. I did some more analytical work, but mostly work of a different type. In fact, when I went to Johns Hopkins in 1881 Professor Remsen looked over my notebook of analytical chemistry and said, "You do not need to study analytical chemistry here"; although the majority of the graduate students who went to Johns Hopkins at that time were required to take a course in analytical chemistry before they began their work for a degree. That work at Grinnell included, among other things, the determination of graphite and combined carbon in cast iron, using an old Liebig combustion furnace of sheet iron and heated with charcoal. I presume I am the only chemist living in America who ever used a furnace of that type.

The second year after graduation Professor Herrick, the head of the department, wished to go back to Yale for some graduate work and I was asked to take charge of the department of chemistry that fall, 1880, which I did, and went on doing some further chemical work in the direction of study myself.

I went to Johns Hopkins in January, 1881. After I had worked for nearly three months, Professor Remsen called me into the balance room one day and asked me if I would undertake a study of the Frankland method of water analysis for the National Board of Health, for we did at that time have a National Board of Health, although it disappeared long ago. This work was done not under Remsen but under Professor Mallet, of the University of Virginia, and through that summer I received from him three bottles daily containing water and other materials, but chiefly water, gathered over the country, especially where there was reason to suspect that the water had caused disease. I made analyses by carefully evaporating with the addition of sulfurous acid to expel carbon dioxide, evaporating to dryness in that way, scraping the residue from the dish, mixing it with copper oxide and burning it in a tube exhausted with a Sprengel pump of my own construction to get carbon dioxide and nitrogen from the residue. The carbon dioxide and nitrogen I measured in a small narrow tube which I had myself made at Grinnell, graduating it with a millimeter scale by the old Bunsen method and which served my purpose better than the Frankland apparatus which had been provided.

I can not dwell further on details. My training in mathematics at Grinnell had been rather deficient, and instead of taking the regular mathematical course in electrical measurements, I took work in experimental physics under the direction of Professor Rowland. Some of you know that he gave to the world the best determination of the mechanical equivalent of heat which had been made up to that time, and also invented, while I was at Johns Hopkins, the concave grating which has proved so useful in the determination of spectral lines. I took my degree in 1882, three years after I had taken my A.B. and B.S. degrees at Grinnell. You would not allow that sort of thing here, I know, after teaching thirty hours a week for a year in the Grinnell Academy and taking charge of the department for a term.

Professor Adams has spoken of my going to Minnesota as instructor. That was my title, but for two thirds of that year my time was spent in making analyses for the Minnesota Geological Survey and I gave only one short course in organic chemistry toward the close of the year. In September, 1883, I was notified by wire that I had been appointed professor of chemistry at the University of Tennessee, where I spent three years. I am always interested, as I look back, to remember that I was the only Northern man on the faculty, and many of my colleagues had been officers in the Confederate army. We got on beautifully together. In many of my classes I had young men with the initials J. D. (Jefferson Davis) or S. J. (Stonewall Jackson). Those were successful years, and I continued during that time the researches on the oxidation of benzene derivatives with potassium ferricyanide which I had begun at the University of Minnesota.

After that I went to the Rose Polytechnic Institute, where I continued for seventeen years. We had there a course in chemistry. I had to give the whole of it, not only general, but analytical and organic, for those who were going into chemistry, and afterwards, also, the thesis work in the last year of the course. I may say that the researches for at least three or four of the theses carried out by seniors under my direction at the Rose Polytechnic were among the important things which I have done in the way of research in chemistry. During those years I also became interested in the atomic weight of oxygen, as we called it in those days, and made a determination which convinced me that the value for the atomic weight was considerably below the 15.96 which was generally accepted at that time. Professor Morley completed his almost lifelong work on the study of the densities of the two gases, and after he had published his results I took occasion to go over my work and concluded that because I had applied a correction in what I was convinced was the wrong way, my results, if properly calculated, were the same, or very nearly the same, as Morley's. I said nothing about it except to friends, nor did I publish anything. I was waiting to do that until I could complete the work. I might add, the opportunity given by the facilities at the Bureau of Standards for doing this work was one reason for my going to Washington from the

Rose Polytechnic Institute. In the new determination my value or the mean of my value and Morley's was about one part in 5,000 different from either. I have just a little pride in the fact that the value which is now most generally accepted in the tables comes a little closer to my value than to that of Morley. His was a fine piece of work carefully done.

Then came the offer here. I first learned, through Professor Parr and Professor Bartow, that the University of Illinois was looking for a head of the chemistry department. They asked me at a meeting of the American Chemical Society in New Orleans to consult with them about a suitable candidate. I, of course, consented and talked with them for some little time. As I talked I saw the possibilities which lay before the head at Illinois and I finally asked if they would consider me. (I learned afterwards that they had undertaken the conversation with the intention of offering me the headship). Then President James asked me to come here and look over the field. I did so. One of the questions which President James asked me was, "Is it possible to build a strong graduate department of chemistry here in the Middle West?" I must admit that I was just a little in doubt, but I did think it was worth trying.

The work here has succeeded beyond my hope and expectation. I wish to repeat what has already been said with regard to the foundation laid here by Professor Arthur W. Palmer, that, to my mind, gives him perhaps more right than me to the honor of having the chemistry building bear his name. Not only that, I had two magnificent colleagues, Professor Parr and Professor Bartow, who stood by me through the years that followed (Professor Parr until the end of my term) and were always with me helping in the work of the department. In addition, the department was so well organized and we had such able men as the heads of the divisions that I could delegate to them a large part of the work being done. The growth of the department depends upon this cooperation between a group of men who worked together and succeeded.

Again, let me thank my colleagues and the board of trustees of the University of Illinois for the high honor which has been given me.

OBITUARY

JOSEPH GRINNELL

FORTUNATELY the editor of SCIENCE requests of me an "obituary notice" of Joseph Grinnell. This frees me from any attempt at a biography, even a sketchy one, of the man.

First, then, as to the great loss to family, friends, the University of California in general and its Museum of Vertebrate Zoology in particular, and to the realm of knowledge to which he devoted his life—the loss to all these is heavy indeed, the more because of its untimeliness. At the very climax of his usefulness general and scientific, one's first impulsion is toward the old fatuous query: "Why? But the second, more deliberate impulsion is toward consideration of the man—his personality and achievements—with little regard for the number of years involved.

Born (February 27, 1877) on the fringe of civilization, of parents both naturalists by innate qualities, what cultural influences would be likely to thwart his naturalistic tendencies?

The father, Dr. Fordyce Grinnell, was a government physician to the plains Indians at Fort Sill in the then Indian Territory. The family moved to Pasadena when the boy was seven years old. Here the home became famous as "The Bird's Retreat."

With maturing years in such a home, these following upon the first years as a frontiersboy with Indian children as playmates, little wonder what happened later.

Graduation from the Pasadena High School, A.B. from the Throop Polytechnic Institute (now the California Institute of Technology) and A.M. and Ph.D. from Stanford were unquestionably important happenings. But his "field work," covering so large a portion of Western North America, from far into Alaska to well into Lower California, judged by the time spent at it, by his publications and by the part it played in his classroom teaching and his guidance of graduate students would, I am sure, warrant a judgment about him similar to that passed by Darwin on what the voyage of the *Beagle* did for him: "The first real training or education of my mind."

Grinnell never sacrificed the scientific study of nature to popular or practical or literary interests. This is shown by the 550 or more published works, several of them sizable books sufficiently technical to satisfy any reasonable demand in this direction; and by the men and women who earned advanced degrees by more or less of their work with him and who now are widely scattered over North America in responsible positions of research, administration, teaching in institutions of learning or in government service. But not for a moment should his interest and efforts in general education and the great matter of conservation be forgotten. Some specific information about these interests are shown by his class work as a university teacher, his leadership in the Cooper Ornithological Club and his editorship of its journal, *The Condor*.

More specific information about his achievements comes from a look at the Museum of Vertebrate Zoology. A half hour's inspection of it by anybody at

home in such a place is enough to bring expressions like: What an admirable example of an institution with a plan in process of execution! And the plan—what is it?

Though never coached or even authorized by Grinnell to answer the question, I venture an answer that I think would please him and I hope would be agreed to by all closely connected with the institution. The museum is an important adjunct to an endlessly intensive study of the land vertebrates of a limited geographic region designatable as the Western Slope of North America.

The function of the museum is to serve as a sort of post-mortem laboratory and conservatory for studying such aspects of the creatures as can not possibly be studied while they are alive. Grinnell always subordinated work indoors on dead animals to work out of doors on living ones.

Fortunate indeed for the scholar, no matter what his realm, of whom it may be so honestly said at the end of his life, as of Joseph Grinnell, Well done, good and faithful servant! Long and in manifold ways may your labors go on bearing fruit in their own right and by the labor of others.

WM. E. RITTER

UNIVERSITY OF CALIFORNIA
JULY 4, 1939.

RECENT DEATHS AND MEMORIALS

DR. EDMUND HELLER, the explorer, since 1935 director of the Fleishhacker Zoological Park in San Francisco, previously director of the Milwaukee Zoological Gardens, died on July 18. He was sixty-four years old.

DR. JOHN MELLANBY, Waynflete professor of physiology at the University of Oxford, died on July 15 at the age of sixty-one years.

DR. HEINRICH POLL, for many years director of the Anatomical Institute in Hamburg, died on June 12 in Lund, Sweden.

EIGHT new dormitories, recently erected at the University of Wisconsin, have been named after former distinguished members of the faculty and scholars who have been connected with the university. These include: Chamberlin House, named after Thomas C. Chamberlin, who was president of the university from 1887 to 1892, when he became head of the department of geology in the then newly established University of Chicago; the Refectory has been named Van Hise Hall, after Dr. Charles R. Van Hise, a graduate of the university, from 1886 to 1903 professor in the department of geology and from 1903 until his death in 1918 president of the university.

SCIENTIFIC EVENTS

TRANSFER OF THE BUREAU OF FISHERIES

EFFECTIVE as of July 1, the Bureau of Fisheries became a bureau in the Department of the Interior. For the present, its Washington offices will remain in the Department of Commerce Building.

Secretary Ickes has, for several years, advocated the benefits of grouping conservation activities in the Department of the Interior, and the shift of the Bureau of Fisheries in accordance with the President's reorganization plan fulfils that policy. The bulletin issued by the bureau points out that there is every reason to believe that the bureau will continue to grow and render greater service to the public and that there is no reason to believe that the change will in any way affect the status of employees of the bureau. It will involve changes in procedure to a limited extent, and copies of all regulations or administrative orders concerning employees will be brought to their attention from time to time as occasion requires.

The Bureau of Fisheries, originally an independent commission, was established pursuant to a joint resolution of Congress approved on February 9, 1871. Until July 1, 1903, it retained its independent status and was known as The United States Commission of Fish and Fisheries.

Upon organization of the Department of Commerce and Labor in 1903, it became a bureau in that department, and, in 1913, when separate Departments of Commerce and Labor were established, it became a bureau in the Department of Commerce. The transfer of the Bureau of Fisheries to the Department of the Interior marks an additional step in the evolution of the bureau.

REORGANIZATION OF THE WORK IN ZOOLOGY AT CORNELL UNIVERSITY

A REORGANIZATION and expansion of the work in zoology at Cornell University became effective on July 1. The changes brought about have been contemplated for a number of years, but have been precipitated by the closing, on June 30, 1938, of the Ithaca Division of the Cornell University Medical College. Most of the former members of that division are included in the new department of zoology. As a result of various shifts of personnel and interests over the past three decades, the work in vertebrate zoology and ornithology had become attached to the department of entomology. These fields have now been transferred to the new department of zoology.

As a result of these changes, the staff of that de-

partment and their fields of specialization are as follows:

General Zoology and Invertebrates: Assistant Professor B. P. Young; Dr. W. E. Heming and Dr. Amy G. Mekeel, instructors.

Histology and embryology: Professor Emeritus S. H. Gage, Professors B. F. Kingsbury and H. B. Adelmann; M. N. Bates, instructor.

Physiology: Assistant Professor J. A. Dye.

Biochemistry: Professor J. B. Sumner and Dr. A. L. Dounce, instructor.

Comparative neurology: Professor J. W. Papez and W. A. Stotler, instructor.

Vertebrate taxonomy, ecology and anatomy: Professor A. H. Wright and Assistant Professors G. M. Sutton and Paul Kellogg and H. L. Kutz, instructor.

Ornithology: Professor A. A. Allen, Assistant Professors G. M. Sutton and Paul Kellogg, and H. L. Kutz, instructor.

Animal Genetics: Professor F. B. Hutt.

Parasitology: Professor R. Matheson.

Limnology: Associate Professor C. McC. Mottley.

The two men last named remain members of the department of entomology, but are also members of the department of zoology. Dr. L. A. Maynard, professor of animal nutrition, and Dr. H. H. Dukes, professor of veterinary physiology, are members of the department for three years, serving in an advisory capacity as liaison officers between the department and the Agricultural and Veterinary Colleges. Dr. F. B. Hutt, professor of animal genetics and head of the department of poultry husbandry, is chairman of the department of zoology for the year 1939–40.

The new department is supported by contributions of personnel, equipment and funds for maintenance from both the College of Arts and Sciences and the College of Agriculture. Its headquarters is in Stimson Hall, formerly occupied by the Ithaca Division of the Cornell Medical College, but some members of the department will retain their present quarters in McGraw Hall pending alterations necessary for their accommodation in Stimson Hall. The work in ornithology will remain in Fernow Hall, which in recent years has been specially equipped for studies in that field.

GRANTS OF THE NATIONAL TUBERCULOSIS ASSOCIATION

THE National Tuberculosis Association has announced that the following grants for medical research from July 1, 1939, to June 30, 1940, have been renewed:

For chemistry of the tubercle bacillus, under the direction of Professor R. J. Anderson, of the Sterling Laboratory of Chemistry, Yale University.

For physiological study of the fractions of the tubercle bacillus, under the direction of Professor M. C. Winternitz and Robert M. Thomas, of the laboratory of pathology, Yale Medical School.

For chemistry of carbohydrates and antigenic properties of the fractions of the tubercle bacillus, under the direction of Professor Michael Heidelberger, of the department of practice of medicine, Columbia University.

For microbiology of the living tubercle bacillus, under the direction of Professor M. C. Kahn, Cornell University Medical School.

For relationship between diabetes and tuberculosis, under the direction of Dr. M. Maxim Steinbach, of the department of bacteriology of Columbia University.

For chemistry of tuberculin, under the direction of Dr. Florence B. Seibert, of the Henry Phipps Institute of the University of Pennsylvania.

For improvement of x-ray technique, under the direction of Professor Charles Weyl and S. Reid Warren, Jr., of the Moore School of Electrical Engineering of the University of Pennsylvania.

For clinical studies in association with tuberculin and x-ray researches, under the direction of Drs. Stiehm, McCarter and Lundegren, of the University of Wisconsin.

For a study of the lysis of the tubercle bacillus, under the direction of Dr. Charles Weiss, Mt. Zion Hospital, San Francisco.

New grants were announced:

For study of tubercle bacilli in animals by making them radioactive, under the direction of Drs. I. L. Chaikoff and J. Traum, of the University of California.

For study of intraperitoneal inoculations of tubercle bacilli in animals, under the direction of Dr. H. S. Willis and Dr. C. E. Woodruff, of the Wm. H. Maybury Sanatorium at Northville, Mich.

For a study of the relationship of tuberculosis and adrenal insufficiency, under the direction of Dr. George W. Thorn, Raybrook Sanatorium, New York.

GUGGENHEIM FELLOWSHIPS FOR BRAZIL, CANADA, PERU AND URUGUAY

THE extension of the fellowships of the John Simon Guggenheim Memorial Foundation to four additional countries of the Western Hemisphere has been announced. Brazil, Peru and Uruguay are brought within the Latin American fellowship plan, and Canada is added as a separate unit. These extensions increase the number of countries in which the Guggenheim fellowships are granted to eight. The fellowships offered to Canada will also be available to the Crown Colony of Newfoundland. Puerto Rico also is included.

During the past ten years the foundation has granted eighty-seven fellowships in Argentina, Chile, Cuba, Mexico and Puerto Rico. These Latin American fellowships and the fellowships offered to Canada are all on approximately the same basis as those granted in the United States. Men and women, married and unmarried, of every race, color and creed are eligible on equal terms. The income of the foundation is devoted

to its fellowships, which aim to provide opportunities for men and women of the highest ability to further their work in all fields of knowledge and all branches of the fine arts. Fellows are usually between the ages of twenty-five and forty years. They are appointed solely on the basis of the quality of their accomplishments, past and prospective, with no thought of distributing fellowships by fields of work, by colleges or universities, according to geographical considerations within the countries included in the plans of the foundation, or with regard to any factors extraneous to the question of quality. Thus, funds available for Latin American fellowships will be granted to the most highly qualified candidates regardless of the countries of their origin.

When former United States Senator and Mrs. Simon Guggenheim established the Latin American fellowships as a part of the activities of the John Simon Guggenheim Memorial Foundation, earlier set up in memory of a son and now endowed by them with more than $7,000,000, they said:

> We regard it as necessary that the republics of America should draw nearer to each other in ascertaining for the common benefit what advances have been made by each nation in knowledge, including the solution of common problems, and in the understanding and appreciation of each other's deepest culture. It is our conviction that this may best be accomplished by aiding scholars and artists of proven abilities to carry on research and creative work in contact with the scholars and artists of other lands. Such aid should be afforded under the freest possible conditions to men and women devoted to science and liberal studies, great teachers, creators of beauty, and generally to those devoted to pursuits that dignify, ennoble and delight mankind.
>
> It is with no nationalist or propagandist intent that we desire to make available such assistance. Men and women devoted to pushing forward the boundaries of knowledge and to the creation of beauty, reared with the impress of the same republican institutions and principles of progress, must of necessity approach nearer and nearer together in scientific and artistic respect for each other's attainments and culture. There is, moreover, a republic of learning and art which knows no boundary lines, and we desire only that scholars and artists from the American republics should meet and learn and teach what to them is Truth. For better understanding among the citizens of the American republics nothing is needed but more knowledge—a knowledge of the other's culture that yields nothing in zeal for one's own.

While, during the past ten years, the foundation has granted eighty-seven Latin American fellowships to assist research and creative work in the United States, an almost equal number of citizens of the United States have been granted fellowships for work in Latin America. This is in accordance with Senator and Mrs. Guggenheim's conviction in establishing the Latin American fellowships "that we have much to learn in those countries that are our elder sisters in the civilization of America and much to give their scholars and creative workers."

Under a clause authorizing the appointment of "permanent residents" of the United States twelve scholars of Canadian origin who are members of the faculties of American universities have already been the recipients of Guggenheim fellowships, and two fellows from the United States are now professors in Canadian universities.

The foundation awards an average of sixty fellowships annually in the United States and, in the same ratio of fellowships to the total population of the country, contemplates granting approximately six fellowships a year to Canadians. The stipends of the Canadian fellowships, as those for the United States, will normally be $2,500 a year.

AMERICAN ORNITHOLOGISTS' UNION

THE fifty-seventh annual meeting of the American Ornithologists' Union was held at the Museum of Vertebrate Zoology, University of California at Berkeley, and at the California Academy of Sciences at San Francisco, Calif., from June 19 to 24, with a registered attendance of 248. Thirty scientific papers were read, many illustrated by color slides or films. The three days of sessions included a like number of evening entertainments, open house at the museum, the annual dinner and business meetings of various sections. On Friday, one hundred and eight ornithologists visited Point Reyes to study nesting colonies of aquatic birds on rocky islands along the Pacific Coast. On Saturday and Sunday, forty-two visitors traveled to Point Lobos and the Hastings Research Area.

Officers elected for the new year were as follows: *President,* Dr. James P. Chapin, New York City; *Vice-presidents,* George Willett, Los Angeles, and Dr. J. L. Peters, Cambridge, Mass.; *Secretary,* Dr. Lawrence E. Hicks, Columbus, Ohio; *Treasurer,* Rudyerd Boulton, Chicago; *Council,* P. A. Taverner, Ottawa; Ludlow Griscom, Cambridge, Mass., and Dr. Alden H. Miller, Berkeley, Calif.

The Brewster Medal Award was awarded posthumously to Dr. Witmer Stone for his two volumes on "The Birds of Old Cape May." Two fellows, Dr. Alden H. Miller, Berkeley, and George Willett, Los Angeles; one honorary fellow, Oskar Heinroth, Berlin, Germany, and two corresponding fellows, G. C. A. Junge, Leyden, and David Lack, London, were elected.

In addition to 532 new associate members, seven new members were named as follows: Paul Kellogg, Ithaca, N. Y.; Wesley F. Kubichek, Washington, D. C.; Joseph A. Hagar, Marshfield Hills, Mass.;

Emmet R. Blake, Chicago; Ivan R. Tomkins, Savannah, Ga.; Louis W. Campbell, Toledo; Owen J. Gromme, Milwaukee.

The meeting in 1940 will be held at Boston in October; the following meeting will be held in Denver. The 1942 meeting will be a joint meeting with the eleventh International Ornithological Congress in Philadelphia in May, 1942.

SCIENTIFIC NOTES AND NEWS

A PORTRAIT of Dr. H. Gideon Wells, professor of pathology and director of the Otho S. A. Sprague Memorial Institute of the University of Chicago, has been presented to the university. The portrait, which was painted by Wayman Adams, was placed on public view on June 23, in the auditorium of the Pathology Building.

THE City of Ithaca has presented to Dr. Emile M. Chamot, professor emeritus of chemistry of Cornell University, an engrossed scroll expressing appreciation of his services to the city since 1905 as advisory chemist of the water department. He resigned on June 1.

AT the commencement exercises of Purdue University the degree of doctor of laws was conferred on Josiah K. Lilly, Indianapolis, chairman of the board of the Eli Lilly Company, a trustee of the university from 1927 to 1938. The doctorate of science was conferred on Dr. George N. Hoffer, of West Lafayette, director of the mid-west office of the American Potash Institute, and for many years a member of the teaching staff in the School of Science and of the research staff of the Agricultural Experiment Station, and on Dr. Rodney B. Harvey, professor of plant physiology at the University of Minnesota and head of the section of plant physiology at the Experiment Station.

THE South Dakota School of Mines at its commencement exercises on June 1 conferred the honorary degree of doctor of engineering on Dr. Harrison E. Howe, of Washington, D. C., editor of *Industrial and Engineering Chemistry*.

AT the graduation ceremony of the University of Aberdeen held on July 6, the honorary degree of doctor of laws was conferred on Dr. C. L. Burt, professor of psychology in the University of London, and on Dr. A. Low, from 1925 until 1938 professor of anatomy in the University of Aberdeen.

THE University of Oxford has conferred the honorary degree of doctor of science on Sir Edward Mellanby, secretary of the Medical Research Council.

It is reported in *Nature* that the following have been elected to the physical mathematical class of the Prussian Academy of Sciences: Professor A. Butenandt, director of the Kaiser-Wilhelm Institut für Biochemie in Berlin; Professor K. Meyer, director of the Institut für Ackerbau und Landbaupolitik, Berlin; Professor A. Ludin, professor of hydraulic and agricultural hydraulic engineering, Berlin; Dr. F. Seewald, director of the Deutsche Versuchsanstalt für Luftfahrt, Berlin, and Professor J. Bartels, professor of geophysics, Berlin.

DR. DONALD C. BALFOUR, of the Mayo Foundation, and Professor Peter Bull, of Oslo, were admitted as honorary fellows of the Royal College of Surgeons, England, at the quarterly meeting of the council on July 13.

DR. CARL CORI, professor of zoology at the German University at Prague, celebrated the fiftieth anniversary of his doctorate on July 7.

THE Goethe Medal for art and science has been conferred on Dr. Eugen Fischer, professor of anthropology at Berlin.

THE following members of the faculty of Cornell University have retired with the title of professor emeritus: Vladimir Karapetoff, electrical engineering; Heinrich Ries, geology; Albert E. Wells, mechanic arts, and Edward A. White, floriculture and ornamental horticulture.

DR. FRANK A. WAUGH, for thirty-seven years professor of landscape architecture and horticulture at the Massachusetts State College, retired with the title of emeritus at the end of the academic year. A dinner was recently given by his friends and former students at which it was announced that a fund had been established in his honor to provide financial aid for students in the department. Assistant Professor Raymond H. Otto has been made head of the department.

DR. RAYMOND B. ALLEN, since 1936 dean of the Wayne University College of Medicine, has been appointed executive dean of the Chicago colleges of the University of Illinois. He will coordinate the educational and research activities of the medical, dental and pharmacy units.

DR. HARVEY E. JORDAN, professor of histology and embryology and assistant dean of the department of medicine of the University of Virginia, has been appointed dean to succeed the late Dr. James Carroll Flippin.

HARRY J. REED, acting director of the Agricultural Experiment Station of Purdue University, a member of the staff for twenty-two years, has been appointed

dean of the School of Agriculture and director of the Agricultural Experiment Station and of the Department of Agricultural Extension. He succeeds Director J. H. Skinner, who has been on leave for some months because of illness and who has retired.

DR. R. T. CRAWFORD, chairman of the astronomical department of the University of California at Berkeley, has been made director of the Students Observatory.

DR. JOSEPH HINSEY, professor of physiology and head of the department at the Cornell University Medical College, New York City, has been appointed professor of anatomy and head of the department of anatomy.

DR. EDMOND J. FARRIS, associate in anatomy in charge of operations at the Wistar Institute of Anatomy and Biology, Philadelphia, has been named executive director. He succeeds Dr. Milton Jay Greenman, who died on April 7, 1937.

MORRIS E. LEEDS, founder and president of the Leeds and Northrup Company, Philadelphia, known for his work in the development of electrical and heat measuring apparatus, has become chairman of the board of the company. He is succeeded in the presidency by C. S. Redding, vice-president in charge of engineering research. Mr. Leeds is president of the Board of Education of Philadelphia and of the Board of Managers of Haverford College.

PROFESSOR LELAND E. WEAVER, of the extension department of poultry husbandry at Cornell University, will spend next year at the University of Hawaii, in an exchange of professorships with Professor C. M. Bice.

DR. FRANKLIN S. HARRIS, president of Brigham Young University, has been given a leave of absence to accept a commission of the Government of Iran to reorganize its Department of Agriculture and to plan for the rehabilitation of the agriculture of the country. Prior to becoming president of Brigham Young University in 1921, Dr. Harris was director of the Utah Agricultural Experiment Station and was earlier professor of agronomy at the station. During his absence Dr. Christen Jensen, dean of the Graduate School, will serve as acting president of the university.

AMONG the investigators stationed this summer at the Scripps Institution of Oceanography at La Jolla, Calif., and the subjects on which they are working are: W. C. Jacobs, U. S. Weather Bureau, possible relations between slow changes in sea level and variations in meteorological conditions; Dr. F. P. Shepard, University of Illinois, and his assistant, Kenneth Emory, analyzing data on submarine geology and obtaining new facts; Dr. Victor Schechter, the College of the City of New York, marine biological problems; Dr. Roy W. Drier, Michigan College of Mining and Technology, the possibility of spectrographic analysis of bottom sediments; Dr. R. H. Tschudy and W. F. Whedon, studying for the United States Navy the organisms which cause fouling growth on ships' bottoms; Otis Barton, inventor of the bathysphere; Granville Ashcraft, University of Southern California, analysis of sea water; Dr. D. W. Johnson, Columbia University, study of old shore lines; H. B. Holmes, U. S. Bureau of Fisheries, temperature distribution in reservoirs and lakes, and E. Palmer, Federal Bureau of Fisheries, Stanford University.

DR. CARLOS E. CUMMINGS, director of the Buffalo Museum of Science, New York, who is chairman of a committee to make a special report to the Rockefeller Foundation on the scientific and educational exhibits of the world fairs in New York and California, recently visited San Francisco to make a survey of the Golden Gate Exposition. He was accompanied by Chauncey J. Hamlin, president of the Buffalo Society of Natural Sciences; Trevor Thomas, Liverpool, England; Dr. Hu, Shanghai, China; Francis Young, Boston, Mass.; Harry Geiger, Los Angeles, and Stanley Stubbs, New Mexico.

PROFESSOR ERNEST B. BABCOCK, of the College of Agriculture of the University of California, has been invited to serve as president of the section of genetics of the seventh International Botanical Congress.

DR. B. J. C. TE HENNEPE, bacteriologist of the State Serum Institute at Rotterdam, arrived in New York on July 21 as the head of a European delegation to the World Poultry Congress to be held in Cleveland, Ohio, from July 28 to August 7. The delegates were from Holland, Belgium and France.

SIR THOMAS LEWIS, physician to the University College Hospital, London, specialist in heart disease, has been appointed to the annual Edward K. Dunham Lectureship for the Promotion of the Medical Sciences in the Harvard Medical School for the coming academic year.

PROFESSOR J. BJERKNES, director of the Geophysical Institute, Bergen, Norway, will give a series of lectures and seminars on various phases of modern meteorology at the Meteorological Office, Toronto, from August 10 to 26. These lectures will be given daily, and all meteorologists are invited to attend and take part in the discussion. A number of rooms are available in one of the university residences at a nominal rate on application to J. Patterson, controller, Meteorological Service of Canada, 315 Bloor St., W., Toronto. These lectures are made possible by a grant from the University of Toronto.

APPLICATIONS must be on file with the United States Civil Service Commission at Washington, D. C., not later than August 14 for the positions of senior engineer with a salary of $4,600 a year; of engineer, with a salary of $3,800 a year; of associate engineer, with a salary of $3,200 a year, and of assistant engineer, with a salary of $2,600 a year. Vacancies in these positions in Washington, D. C., and in the field, and in positions requiring similar qualifications will be filled from these examinations, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion. The salaries given above are subject to a deduction of 3½ per cent. toward a retirement annuity.

THE National Research Council has continued for the fiscal year 1939–40 its subscription to a table in the Naples Zoological Station. Qualified investigators wishing to enjoy the facilities of the Naples Laboratory should make application to the office of the Division of Biology and Agriculture, National Research Council, 2101 Constitution Avenue, Washington, D. C.

DISCUSSION

PRESENT-DAY BOTANY IN ITALY

A MUCH-BELATED number of the *Nuovo Giornale Botanico Italiano* (Vol. 45, No. 1) celebrates the fiftieth anniversary jubilee meeting (1938) of the founding of the Italian Botanical Society and the two hundredth anniversary of the death of the distinguished Florentine botanist, Pier Antonio Micheli (1679–1737). Addresses by the president of the Botanical Society, Professor Napoleone Passerini, and by the secretary, Professor Alberto Chiarugi, describe the founding of the organization and its fifty years' accomplishments. The society now has 209 members, most of them in the neighborhood of Florence and Pisa and in northern Italy, but some in every province of the kingdom. The published "commemorative oration" by Professor Giovanni Negri is an appreciative twenty-five-page account of the life and work of Micheli, "father of mycology," author of "Nova Plantarum Genera."

The publication includes about thirty contributions in various fields, as: morphology, anatomy, physiology, mycology, ecology and geographical botany. Among the longer articles is one by Rodolfo P. Sermolli, describing and illustrating with three full-page plates some features of the vegetation in higher mountain districts of Italian East Africa. Adriano Fiori lists the plants of a number of the Italian Aegean Islands. Raffaele Ciferri gives an account of the rediscovery of *Emericella variecolor* (Eurotiaceae), a fungus on rotting olive fruit. Ciferri and Giglioli propose a "formula"—based on a definite schedule of description—for describing varieties and forms of wheat. Roberto Corti reports upon collections of plants from Cufra and other oases in southeast Libya and farther south in Tibesti.

This jubilee publication gives some idea of present-day botanical activity in Italy, although it must not be forgotten that there are other Italian botanical journals, besides special publications of some of the universities. The work of Italians in horticulture, agriculture and forestry is somewhat well known in the United States, but their botany has generally received less attention from Americans than it deserves.

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THE PRODUCTION OF UNFERTILIZED SEEDS IN TRILLIUM

TRILLIUM has always been used as an admirable object for cytological investigations on account of the huge size of its chromosomes. This genus, which is found in North America and in Asia, presents cytological peculiarities in both continents. The descriptions of its meiotic divisions reveal extreme irregularities and a large amount of sterility. It has been supposed that these abnormalities were due to the intolerance on the part of the genus to cultivation. The present authors have satisfied themselves that this is not the cause of the irregularities, since they are present just as strikingly in material gathered from normal wild plants as in those under cultivation. As a result of the investigations of the processes leading to the formation of the embryo, in certain species of the genus it became clear that in contrast to the dandelions and hawkweeds (Hieracium) apomixis rather than parthenogenesis is present. The reduction division in the embryo sac mother cell is quite normal in contrast to the situation in the pollen mother cells, and five chromosomes are present. One of the derivatives of the mother cell survives, as is usually the case, and gives rise to an embryo sac. Ordinarily this contains only four nuclei, a situation paralleled by the Onagraceae and allied forms, as well as by certain orchids. Of the four nuclei one becomes the egg and another an abortive synergid. The remaining two nuclei fuse together and form the endosperm nucleus. The pollen tubes usually do not penetrate the ovary and in the rare cases that this happens, they do not effect fertilization. There is as a consequence no fecundation of either the egg or the endosperm as a result of

fusions effected by nuclei from the pollen-tube. In spite of the absence of fertilization the egg develops into an abortive embryo in which the divisions show five chromosomes; in other words, the embryo is haploid. This embryo does not attain any considerable size and ultimately aborts. The endosperm, which is diploid as a result of its method of origin, forms in the usual manner and first contains a large central cavity around which are rapidly dividing cells. After the abortion of the haploid embryo and after the endosperm has reached considerable degree of development, a diploid embryo makes its appearance in the micropylar region of the endosperm and is continuous with the endosperm tissues. This is the embryo which perpetuates the plant. Frequently with the abortion of the haploid embryo the whole seed aborts. In other cases the seeds may reach a certain size without any embryos in them at all and in a number of instances what appear superficially to be seeds, even when relatively mature, do not contain an embryo. In certain cases all the seeds in an ovary may be in this condition. In all the mature seeds examined by the present writers in the following species of Trillium embryos produced from the endosperm were found to be present: *T. grandiflorum, T. erectum, T. undulatum* and *T. sessile.*

It would appear from the abnormal method of reproduction in Trillium that too great importance can not be attached to the reproductive chromosomes of the anthers and their behavior.

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THE ROLE OF ARRHENOTOKY IN THE ADAPTATION OF INSECTS

THE sperms of Hymenoptera appear to be only female-producing. The lack of male-producing sperms is correlated with the production of males from unfertilized eggs, a form of parthenogenesis known as arrhenotoky. Since the production of females in arrhenotokous Hymenoptera only takes place after mating and since oviposition in many species occurs as readily before as after mating, a preponderance of males might be expected. Actually, however, arrhenotokous Hymenoptera as a rule produce more females than males.

This preponderance of females is possible because of the presence in insects of a mechanism for the storage and conservation of sperms. This mechanism consists of a spermatheca (sperm reservoir), the spermathecal gland, the sperm duct and associated nerves and muscles. The primary function of this mechanism is to discharge a limited number of activated sperms upon each egg as it passes down the oviduct. When a species produces males from unfertilized eggs this mechanism automatically becomes the means of controlling the proportion of the sexes. When it functions females are produced; when it fails to function males are produced.

The fact that, in the Hymenoptera in general, there is a preponderance of females shows that mating usually occurs before oviposition and that the spermatheca contains sufficient sperms to fertilize most of the eggs. Since male progeny also are produced by the female before its supply of sperms is exhausted, it is evident that some stimulus other than the mere passage of the egg through the oviduct is needed to cause the discharge of sperm in Hymenoptera. This operation appears to be dependent on two sets of reflexes: one involving the spermathecal gland (the stimuli originating externally); the other the spermathecal muscles (the stimuli originating internally with the movement of the eggs through the oviduct). The glandular reflex apparently serves to activate the stored sperms; the muscular reflex apparently synchronizes the discharge of sperms with the expulsion of the egg. Lack of fertilization results either from inadequate stimulation, an excessive rate of oviposition or lack of sperm.

Since in the Hymenoptera the activation of sperms is a result of environmental stimulation, it is evident that the environment controls the sex ratio in most species. As a result of such control extreme variability characterizes the sex ratio in this group of insects.

The fact that, in general, there exists a preponderance of females indicates a remarkable adaptation to environment.

In this connection it is interesting to note a phenomenon which occurs in a few species of Hymenoptera and is correlated with the preponderance of females. This is intra-specific hyperparasitism: a phenomenon also dependent on arrhenotoky. In this type of parasitism all the males, in most species, are the progeny of unmated females and in pure cultures are obligatory parasites of the immature stages of the female. The females are obligatory parasites of scale insects and mealy bugs. Male hyperparasitism, however, is not necessarily entirely intra-specific. In at least one species the male appears to be an obligatory inter-specific hyperparasite, rarely, if ever, parasitizing the immature female of its own species. Such a species would be unable to reproduce in pure cultures. The hyperparasitic males develop under diverse environmental conditions. In extreme cases the males develop only ectoparasitically in a dry environment, whereas the female develops endoparasitically in a fluid environment. The adults of both sexes frequent like environments.[1]

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[1] *Ann. Ent. Soc. of Amer.*, 32: 11–26, 1939; *Univ. of Calif. Publ. in Ent.*, 6: 401–422, 1937.

MOTTLED ENAMEL IN RAT MOLARS

IN an experiment planned to learn the conditions for producing mottled enamel in rat molars, we have fed members of unreduced litters of albino rats, born and suckled on a sucrose-casein type of ration, graded daily doses of fluorine as sodium fluoride by pipette. The amounts given were 0, 1, 2, 4, 8, 16, 32 . . . micrograms each, respectively, to as high as 256 micrograms to a single rat, the tenth in its litter. The rats were weaned at 21 days and fluoride feeding was discontinued. The animals were then placed on a ration of yellow corn meal 66, whole milk powder 30, alfalfa powder 3 and sodium chloride 1, for eight weeks and sacrificed.

The first and second molars of both the maxillae and mandible of the rat which had 256 micrograms of fluoride showed dull white, deeply corroded enamel. Particularly the cusps of the upper molars appeared denuded of enamel. The third molars appeared normal. Two rats which received 128 micrograms of fluorine daily showed a diffuse milkiness of the enamel at the gingival line of the first two molars and some rounding of cusp edges. Other rats, 34 in all, receiving less than 128 micrograms of fluorine, had apparently normal molars.

The high dosage of fluorine required to produce mottled molars is more evidence that the rat is less sensitive to fluorosis than man.

The successful production of mottled enamel in the permanent teeth of an animal in which dental caries can also be induced permits direct experimentation of the interrelations of these two diseases. It also provides a means of study of the time relations of the formation of normal and mottled enamels.

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QUOTATIONS

THE NEED FOR EXTENSION OF MEMBERSHIP OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

IN 1931, the centenary year of the British Association, the General Treasurer's Report stated that the activities and liabilities of the association had increased to such an extent that further endowment would be essential in order to consolidate the position which it had attained at the close of its first century.

During the past few years the British Association has not hesitated to extend in fresh directions its activities for the advancement of science.

A new Division for the Social and International Relations of Science was established in 1938. It is charged with coordinating work that deals with these relations both at home and abroad, and with carrying out inquiries and research; and it is empowered to hold meetings not only during the annual meeting of the association, but also independently. The division is in full activity: its organization necessarily involves expenditure; and the fields of inquiry already opened to view indicate that with more ample resources the association will be able to undertake, through the division, new work of national and international importance.

As from October, 1939, the association will cease to publish its report in an annual volume, which is felt to be no longer the most effective medium of publication. Instead, a quarterly periodical will be issued under the title of *The Advancement of Science*. It is confidently expected that this new quarterly will assure a more adequate record of the transactions of the association and engender a wider interest in them; but in order to give full effect to this expectation the association must be in a position to restrict itself less severely than hitherto in the matter of printing costs.

In 1937–38 the association broke new ground by sending a representative scientific delegation to India to join the Indian Science Congress Association in celebrating the jubilee of that body. The practice of organizing such delegations to overseas territories, especially those in which normal meetings of the association could not be expected to take place, is regarded as an imperial service of first importance, and one which the association is peculiarly qualified to render. Proposals for more than one such delegation overseas are under consideration now. But in order to further the extension of this principle, it is obviously desirable that the association should be able to bear out of its own funds a larger share of the cost of delegations than is possible at present.

A happy development of international contacts has recently been inaugurated by the establishing of more intimate relations between the British and the American Associations for the Advancement of Science. It has been agreed that in alternate years the British Association shall invite an American lecturer, and the American Association a British lecturer, to their respective annual meetings. Grants will be made to cover the expenses of the lecturers.

Increased financial resources are essential if the asso-

[1] An appeal signed by P. G. H. Boswell, General Treasurer of the Association, Burlington House, London.

ciation is to take fuller advantage of its opportunities in the directions indicated above, as well as in various other ways. For instance, the practice, adopted in recent years, of offering exhibitions to young students nominated by universities and colleges, enabling them to attend meetings of the association without cost to themselves, is obviously capable and worthy of extension. The presence of distinguished scientific visitors from overseas has always been encouraged at the annual meetings: in present world-conditions it is less easy than formerly for such persons to come at their own expense, and the association is without funds to assist them. The possession of Charles Darwin's house, Down House, in Kent, which is maintained as a national memorial open to the public, offers opportunities which could be realized if the association had means to supplement the endowment which accompanied Sir Buckston Browne's gift of this property.

These wider potentialities in the association's sphere of work have all emerged in recent years; but there must also be borne in mind the field of scientific research and inquiry in which the association has honorably labored almost since its foundation. The ability to make grants for research is of the essence of its being, and to maintain and strengthen this activity is one of the first tasks of every successive general treasurer.

At each of the last seven annual meetings (1932–38) the attendance of members has exceeded 2,000, the average number being 2,375. That average had not been attained in any similar period previously. Here, then, is evidence of growing interest in the work of the association. But of those who attend the annual meetings (apart from life members), only a small proportion—about one quarter—are regular annual subscribers. The remainder subscribe only for the year of any particular meeting which they attend. I need hardly emphasize the difficulties that arise in attempting to budget on a membership income which fluctuates annually as widely as that of the association. The financial position of the association will be greatly strengthened by a substantial increase in the numbers both of regular yearly subscribers and of life members; and this appeal is issued in the hope that such an increase may be achieved. It is addressed to all who appreciate the benefits which science confers, and would wish to aid the association in discharging its function of the advancement of science.

SCIENTIFIC BOOKS

POPULARIZATION OF MODERN SCIENCE

The Wisdom of the Body. By WALTER B. CANNON, George Higginson professor of physiology in the Harvard Medical School. Revised and enlarged edition. 333 pp., with 40 illustrations. W. W. Norton and Company, New York, 1939. $3.50.

The Science of Health and Disease: A Text-book of Physiology and Hygiene. By HOWARD W. HAGGARD, director of the laboratory of applied physiology of Yale University. Revised edition. xiii + 594 pp. with 10 plates and 89 figures and 16 tables. Harper and Brothers, New York, 1938.

The Stuff We're Made of. By W. O. KERMACK, research laboratory, Royal College of Physicians, Edinburgh, and P. EGGLETON, lecturer in biochemistry, The University, Edinburgh. viii + 342 pp. with 8 plates and 55 figures. Longmans, Green and Company, New York, 1938. $3.20.

You're the Doctor. By VICTOR HEISER. 300 pp. W. W. Norton and Company, New York, 1939. $2.50.

Health, Hygiene and Hooey. By W. W. BAUER. 322 pp. The Bobbs-Merrill Company, Indianapolis, 1938.

A CHARACTERISTIC feature of scientific endeavor during the past decade has been the earnest effort on the part of reputable scientists to popularize current scientific ideas and to promote public appreciation of how science may profitably be applied in everyone's daily life. Naturally this effort concentrates along biological lines with special attention to individual and public health. The publication of Paul de Kruif's "Microbe Hunters" in 1926 set an example which a host of followers have tried to imitate.

Some of the current efforts to popularize new scientific ideas are included in the books reviewed here. These range in style from the dignified and often technical presentation of Professor Cannon to the smart fast-moving wisecracks of Dr. Bauer.

Professor Cannon's volume brings up to date his 1932 exposition of the same title. It also adds a new chapter on the effects of age on homeostatic mechanisms. For the coordinated physiological processes which maintain the complex steady states in the organism peculiar to living beings, involving, as they may, all organs and parts working cooperatively, Professor Cannon suggests the special designation, *homeostasis*. He introduced this term in order to differentiate these steady physiological states, characteristic of living things, from the relatively simple physico-chemical states in closed systems where forces are balanced and where the constant condition may be termed equilibrium. In this volume Professor Cannon considers "first, what may be regarded as the fundamental condition of stability, then the various physiological arrangements which serve to restore the normal state

when it has been disturbed, and finally, the narrowing limits of adaptation imposed by age." The book, of course, is a classic and is already one of the most influential in the development of fundamental theory of modern physiology. That its popular presentation is appreciated widely enough to require a revised second edition, is clear testimony to the skill and clarity with which Professor Cannon has developed his idea.

In his introduction to Professor Haggard's volume, Professor Yandell Henderson, brilliant and blunt as always, says it is designed "for employers and engineers in charge of labor," as "a text-book for college students," and that "every educated man should see it." It clearly and convincingly develops the thesis that modern medicine is almost entirely a matter of applied physiology. As a text-book, it could be considerably improved by the inclusion of references to significant articles or reviews. It might also be improved by some degree of personalization, that is, by indicating who some of the scientists have been who have contributed to the gathering of the information which Professor Haggard reports so impersonally.

Dr. Kermack and Dr. Eggleton's book is the first to make a consistent effort to interpret biochemistry to the public. It is admirably designed and clearly developed. These Edinburgh scientists begin by placing living things in proper proportion to the rest of the universe. They next discuss the limitations of the scientific method and go on to explain how the complex molecules of living things are built up from a relatively small variety of atomic bricks. The discussion of foodstuffs is from the standpoint of "the biological motor car." In connection with growth, repair, reproduction and special functional adaptations, the authors make illuminating observations on such matters as the economics of forced labor, the proper design of bicycles and Olympic champions. Vitamins, enzymes and hormones are entertainingly discussed. Even the no-man's-land where what is living is not to be clearly distinguished from what is not living, is bravely probed. It is in every way a beautiful work. It could, however, be improved by judicious bibliographical references to readily available original sources.

Dr. Heiser's program for personal health is a remarkable combination of clever organization, hard horse sense born of much wisdom and experience and entertaining personal anecdotes. As in the case of "An American Doctor's Odyssey," Dr. Heiser's "You're the Doctor" gives evidence of professional journalistic organization. These are some of the chapter titles: "The All-devouring Gut," "Brother Rat," "Diet and Health with Key to the Vitamins," "How Now, Brown Cow," "A Little Poison Now and Then," and "Wher'er I Roam." The general point of the whole volume is summarized in the last chapter, headed "A Merry Heart Doeth Good Like a Medicine."

Frankly journalistic is Dr. Bauer's "Health, Hygiene and Hooey." To those familiar with the medical quackery exposés in *Hygeia* and the *Journal of the American Medical Association,* Dr. Bauer's technique is well known. The information is essentially sound, and its presentation is entertaining. Dr. Bauer wisely remarks: "The best safeguard against exploitation is a knowledge of principles. Individual exploiters come and go; nostrums rise, flourish and vanish; quackery is different every day and yet, fundamentally, the same. A person who understands the characteristics of charlatanism will not be fooled by the individual exploiter. Therefore, I have not chosen to 'name names,' but rather to set up principles. . . ." Some of the chapter headings illustrate his method: "Wim, Wigor and Witamins (pinpricks in the vitamin inflation)"; "Soft Soap and Skin Games (facts and nowhere-near facts about the skin you love to retouch)"; "A Fake for Every Ache (common symptoms pay dividends to the quack and charlatan)"; "Life Begins Before Birth (we will grow old—why not gracefully?)"; "Common Sense, Preferred (how to be happy though healthy)." The book contains much factual information, but again fails to document more readily available sources.

Popularization of modern science may become a socially beneficial procedure. The success of the effort depends largely upon its sincerity. Journalistic tricks are justifiable if they stimulate attention, provoke entertainment and supply the essential information. Science popularizers should write simply without condescension and clearly, without emphasizing the obvious. When prepared by a master in his own right, as in the case of Professor Cannon, the result is likely to become not only a classic in science, but in general literature as well.

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REPORTS

ASTRONOMICAL SYMPOSIUM ON GALACTIC AND EXTRAGALACTIC STRUCTURE

IN connection with the dedication on May 5 of the W. J. McDonald Observatory of the University of Texas—a joint project of the University of Texas and the University of Chicago—an astronomical symposium was held at the observatory. The purpose of this symposium was to bring together the leading experts in the various fields of astronomy directly or indirectly working on the general problem of galactic and extra-

galactic structure, and to present, in the form of a series of connected lectures and discussions, a unified picture of the present views concerning the structure of the universe. The symposium was sponsored by the Warner and Swasey Company—the builders of the 82-inch McDonald telescope—and through the generosity of this famous firm many astronomers from this country and from abroad were invited to participate in the symposium. The general character of the symposium may well be described by quoting the words of one of the participants, Dr. J. H. Oort, of the University Observatory, Leiden, Holland:

> The question of the general dimensions of the galactic system, which preoccupied astronomers around the beginning of this century and which stimulated Kapteyn, in 1906, to develop the plan of selected areas, can no longer be considered as one of the burning problems of to-day. We might venture to say that another group of problems, *viz.*, those connected with the spiral structure of stellar systems, is now generally coming to the foreground. The great majority of, and possibly all, stellar systems of great flattening show such a structure, and it is natural to conclude that the galactic system would exhibit similar structure if looked at from a suitable position. This is evidently an important problem, as it may well be expected that the study of possible spiral structure in the galactic system may help to elucidate the character of spiral structure in general.

In order to elucidate the spiral structure of galaxies, we must systematize our knowledge of the various units of which these galaxies are composed: the stars, the cosmic dust clouds and the gaseous nebulae. In the discussions frequent reference was made, especially by Professor H. N. Russell, of Princeton, to the possibility that an additional unit may ultimately be found in the form of "chunks," ranging in size from meteoric particles to Jupiter, but there is as yet no direct observational evidence of such "chunks" outside the solar system.

In order to estimate the mass of our galaxy we must know the masses of the individual stars. Professor Russell's paper was devoted to the problem of determining the masses of the stars from observations of binary motion. While, in principle, the problem is simple, there are many serious difficulties in practice, and a large part of the discussion was devoted to the elimination of accidental and systematic errors in the parallaxes, etc. The data obtained by Professor Russell yield a new expression for the mass-luminosity relation (in solar units):

$$\text{Log } L = 3.82 \log \bar{m} - 0.24$$

Professor G. P. Kuiper, of the Yerkes Observatory, discussed a little-known group of stars which are somewhat less luminous than ordinary dwarfs, but which can not be identified with the true white dwarfs. For these stars Dr. Kuiper suggests the name of subdwarfs. Two dozen of these stars were discovered by him during the first six weeks of regular use of the 82-inch McDonald reflector. In addition, Dr. Kuiper announced the discovery of two new white dwarfs.

The problem of stellar colors and stellar spectra is of particular importance for the interpretation of the structure of our galaxy, because only after we have determined the colors and the spectra can we estimate the effect of the absorbing dark clouds in interstellar space upon the apparent distribution of the stars in the Milky Way. This problem was discussed by Mrs. Cecilia Payne Gaposchkin, of Harvard Observatory. Of particular importance is her discussion of the systematic errors of the Potsdam system of spectral classification and the conclusion that "the negative density gradients for blue stars that have been derived by others for the area in Carina (S.A. 193) are partly a result of the systematic errors of spectral classification."

A powerful new method for the determination of star colors was outlined by Dr. W. W. Morgan, of the Yerkes Observatory. When these colors are combined with spectroscopically determined luminosities they serve to give us reliable values of selective interstellar absorption. Several excessively red B stars were discovered in this work, and it was pointed out that an excessively red star may be either of type N or of type B—the latter, of course, being reddened by interstellar absorption.

The problem of space reddening was discussed by Professor Joel Stebbins, of the Washburn Observatory, University of Wisconsin, who, together with Drs. Huffer and Whitford, has determined photoelectric colors of 1,300 B-type stars. The main conclusions of the paper are: ". . . the dark clouds of interstellar material are located close to the main plane of the Milky Way; they are irregularly distributed and do not make up a thin uniform layer. The absorption of light is much greater for stars toward the center than toward the anticenter of the galaxy, and even the brightest parts of the Milky Way are only half as bright as they would be if we could see them in the clear."

The effects of interstellar reddening are so conspicuous and there are so many excessively red stars of early spectral type that it is difficult to understand how the effect could have remained controversial until less than ten years ago. The profound influence of our recognition of interstellar absorption upon theories of galactic structure is one of the most significant advances of recent years.

Professor Harlow Shapley, of the Harvard Observatory, discussed the importance of variable stars in

the measurement of great distances. A large number of cluster-type Cepheids in high galactic latitudes has been used to determine the thickness of our galaxy and the law of galactic concentration for cluster-type Cepheids. Important applications of variable stars have also been made at Harvard to the determination of distances of external galaxies.

The problem of diffuse, reflecting matter in space was discussed by Dr. C. T. Elvey, of the McDonald Observatory. Elvey and Rudnick have discovered a new faint glow in the Milky Way which comes from star light that is reflected by large numbers of very small particles. The existence of this "galactic light" has recently been confirmed by Henyey and Greenstein at the Yerkes Observatory.

The composition of the interstellar gas was the topic of a paper by Dr. O. Struve, of the Yerkes and McDonald Observatories. The principal result is the very large abundance of hydrogen.

Dr. Bart J. Bok, of the Harvard Observatory, gave an account of important investigations which are now being carried on under his direction at Harvard. The work is based upon accurate star counts which are used to determine first the interstellar absorption and then the space distibution of the stars in our galaxy. The presence of considerable negative density gradients in stellar distribution was discovered for several Milky Way regions.

The importance of galactic clusters in problems of Milky Way structure was stressed in a paper by Dr. R. J. Trumpler, of the Lick Observatory of the University of California. "When the known galactic star clusters are projected on the galactic plane, their arrangement shows no relation to the generally accepted structure of the galactic system, but indicates a grouping with the sun near its center. . . . The possibility that star clusters are confined to outer regions of our stellar system and are missing in its central condensation is indicated by the examination of extragalactic nebulae. A large number of undiscovered distant clusters, however, should be expected in galactic longitudes 0°–70° and 220°–290°. In the former region the strong obscuration marking the dark division of the Milky Way is probably responsible for the scarcity of known clusters. It is suggested that the search for distant clusters should be made by photographs utilizing red light, as the latter has a greater penetration of absorbing (scattering) material."

Dr. J. H. Oort finds that the

star densities indicate a curious distribution: a region of relatively small density near the sun is found to be surrounded in all longitudes by extensive regions where the density is two or more times higher; this is a large-scale structure, showing equally on both sides of the galactic plane. The plausible comparison with spiral structure presents, however, a difficulty in the unexpected increase of density found when proceeding from the sun in the two opposite longitudes perpendicular to the direction of the center. This warns us not to accept these results without reserve. The principal assumption involved could, however, be verified to some extent by the color-excesses. One of the most urgent needs appears to be the further study of color-excesses, also in low latitudes, so that the density distribution may also be determined in regions near the galactic plane. An essential but difficult point is the determination of the relation between color-excesses and total absorption.

An accurate photometric study of the extragalactic system IC 1613, a member of the local group of galaxies, was presented by Dr. Walter Baade, of the Mount Wilson Observatory. Astronomers will especially welcome the extension of the photographic scale to magnitude 21.0. This has enabled Dr. Baade to determine accurate light curves of 20 Cepheid variables with periods between 146 days and 3 days and to determine a new period-luminosity curve from his data.

Dr. Harlow Shapley spoke on the distribution of external galaxies made at the various stations of the Harvard Observatory. Attention was called to the uneven distribution of the external galaxies in different regions. The structural features of extragalactic nebulae were reviewed by Dr. Edwin Hubble, of the Mount Wilson Observatory. The photographs secured by him with the large reflectors at Mount Wilson suggest "the segregation of material already distributed through the nebulae rather than the ejection of material into previously unoccupied regions. The patterns appear to develop inside the central lenses or within the surrounding envelopes. In early barred spirals (SBa), however, incipient spiral structure is generally found at the rims of the central lenses or of the surrounding envelopes. The further development of spiral structures progresses smoothly, along several closely parallel lines, to the familiar late type patterns (Sc and SBc)."

The theoretical interpretation of spiral structure was the subject of a paper by Dr. Bertil Lindblad, of the Stockholm Observatory (Sweden).

In the case of nebulae with thin spiral arms, as exemplified by the nebula M 81, the arms can be well represented by the asymptotic orbits extending from a spheroidal central mass. The tidal effects of ejected matter on the matter moving at the edge of the central system may lead to a successive dissection of the original central system and in favorable cases to a heavy spiral structure like that of M 51. From the point of view of this theory the abundance of spiral nebulae of a fairly uniform type concerning essential features like the form of the arms, the number of turns of the spiral whorls around the center, etc., seems possible to understand. The theory favors the opinion that the direction of rotation of the system agrees with the direction in which the

spiral arms wind around the center when followed outwards from the nucleus.

Dr. S. Chandrasekhar, of the Yerkes Observatory, presented a new theory of stellar motions which is applicable to various types of stellar systems, and which will doubtless revolutionize stellar dynamics.

Professor E. A. Milne, of the University of Oxford (England), gave a lecture on "Cosmological Theories," in which he begins,

> with a logical analysis of the large-scale universe of matter and motion as it appears to observation, avoiding any appeal to laws or concepts derived from smaller-scale phenomena. . . . Starting from the individual's awareness of the passage of time, it is possible to set up a system of congruent timekeeping in different places, to construct in turn a kinematics and a dynamics, hence to give a logical meaning to "uniform time," to give accounts of gravitation and electromagnetism, and finally to show how to identify the various logical constructs so encountered in the physically observed universe. . . . The stimulus for the development of this logical structure has arisen from the great American discoveries of the phenomena associated with the extragalactic nebulae. Such discoveries have justified us in formulating our deepest questionings, and have helped to separate questions which are genuine questions from those which have merely conventional answers.

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SPECIAL ARTICLES

LINKAGE OF PEA COMB AND BLUE EGG IN THE FOWL

RECENT studies in this laboratory show that the dominant gene causing blue shells on eggs of the domestic fowl is closely linked with that for pea comb. During the last two decades a number of fowls that lay blue eggs have been introduced into this country and to Europe from South America. These vary considerably in color of plumage and in structural characteristics. In most cases they resemble Dark Brown Leghorns in color but have pea combs. They are generally called "Araucanas" after that region in Chile in which they are most abundant.

Unlike the brown pigments of hens' eggs, which are applied on the surface only, the blue color is found all through the shell and is quite evident on the inside. When the blue is combined with varying shades of brown (as in egg-shells of Rhode Island Reds and other breeds) the result is a series of green and olive colors, varying with the intensity of the brown color. The ability to lay blue eggs results from a unifactorial dominant autosomal mutation.[1]

In February, 1938, the writers obtained a male Araucana descended from stock imported from South America and mated it with a number of females, including "testers" for two autosomal linkage groups. This male had a pea comb, and all but one of the females had single combs. Among 35 laying daughters from single-combed dams, the following combinations were found:

Parental combinations	
Single comb, white egg:	18
Pea comb, blue egg:	15
Cross-overs	
Single comb, blue egg:	0
Pea comb, white egg:	2
	35

[1] R. C. Punnett, *Jour. Genet.*, 27: 465–470, 1933.

Such a distribution could not occur by chance. The possibility that one gene is responsible for both type of comb and color of egg-shell seems very unlikely, because Brahmas, Sumatras and Cornish Indian Games, all pea-combed breeds, do not lay blue eggs. Evidently the Araucana male was heterozygous for pea comb and for blue egg, carried in the coupling phase. Since in 35 gametes only two cross-overs occurred, the amount of crossing over between the two genes is apparently not more than 6 per cent. Tests to measure this figure more exactly are in progress.

Hertwig[2] found 32.8 per cent. crossing over between pea comb and marbling (a pattern in the down of chicks) and 45.6 per cent. between marbling and naked neck. Confirmation of the latter association is desirable because of the long map distance involved. Though the gene for blue egg is now added to this group, its usefulness for further mapping of the chromosome is likely to be somewhat limited because it is manifested only in one sex and even there not until the birds lay. Moreover, its close linkage with pea comb would necessitate large numbers in any linkage test where these two genes were to be separated.

A tentative map[3] for chromosomes of the fowl, published in 1936, showed 18 genes in five linkage groups. Since then the "naked" gene has been added to the sex chromosome[4] and the addition of blue egg makes a total of 20 genes in the five groups. Some of these, as well as one or two other loose linkages that have been suggested, need further study.

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[2] P. Hertwig, *Verhandl. Deutschen Zoolog. Gesell.*, pp. 112–118, 1933.

[3] F. B. Hutt, *Neue Forschungen in Tierz. u. Abstammungslehre (Duerst Festschrift)*, Bern, pp. 105–112, 1936.

[4] F. B. Hutt and P. D. Sturkie, *Jour. Hered.*, 29: 370–379, 1938.

ROLE OF VITAMIN E IN THE PREVENTION OF MUSCULAR DYSTROPHY IN GUINEA PIGS REARED ON SYNTHETIC RATIONS

MADSEN *et al.*[1] were the first to attain any notable success in inducing the guinea pig to eat synthetic rations. In the course of their experiments they observed the relatively early appearance of severe muscular dystrophy not unlike the lesions first extensively studied by Goettsch and Pappenheimer.[2]

When the cod liver oil was removed from the diet, being replaced by other substances which satisfied the A and D requirements, the dystrophies were not prevented but were very notably delayed. It was hence apparent that the dystrophies were not actually caused by the cod liver oil, although they were precipitated and exaggerated in some unknown way by it.

Some three years ago we began the study of the nutritional requirements of guinea pigs with synthetic rations. With a slight modification of the diet of Madsen *et al.*, we have had no difficulty in producing the early severe dystrophies of these observers. This animal material, with the particular diet employed—a diet in which the increased proportion of cod liver oil seems responsible for particularly early and severe dystrophy—appeared ideally adapted for experiments attempting evaluation of the possible role of vitamin E in the prevention of such dystrophies.

A year was spent demonstrating that the administration of 0.75 cc or even of 0.5 cc of wheat germ oil daily to guinea pigs on this diet prevented the development of dystrophies up to the 355th day of life, when the experiment was discontinued. The muscle creatine values in these animals were normal. The controls (without wheat germ oil) all developed typical early dystrophies and in each case were sacrificed when practically moribund at times varying from the end of the first to the end of the third month.

These encouraging results with wheat germ oil led us to a repetition of the experiment employing the pure substance, alpha tocopherol, instead of wheat germ oil. In the midst of this work, several important papers appeared, reporting the employment of alpha tocopherol. Barrie,[3] as well as Goettsch and Ritzman,[4] have shown that alpha tocopherol prevents the development of muscular dystrophy in suckling rats from mothers reared and held on low E—facts which we can confirm. Mackenzie and McCollum[5] have also reported that alpha tocopherol cures the dystrophy which develops in rabbits maintained on the Goettsch and Pappenheimer diet, supplemented with 10 per cent. ether extracted wheat germ.

Since Cummings and Mattill[6] have shown that oxidative reactions initiated by the auto-oxidation of cod liver oil are destructive to vitamin E, we fed the cod liver oil (1 cc per os) and alpha tocopherol (3 mg per os) on alternate days. These guinea pigs likewise remained free of evidence of muscular dystrophy and have now been sacrificed on the 200th day of life, showing normal values for muscle creatine.

It is therefore apparent that in another animal form and with a particular dietary regimen in which an early severe dystrophy of the striated musculature invariably appears, alpha tocopherol acts effectively to prevent the dystrophy.

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A QUANTITATIVE STUDY OF MEANING BY A CONDITIONED SALIVARY TECHNIQUE (SEMANTIC CONDITIONING)

IF a human subject has acquired a conditioned reaction to some specific verbal stimulus, let us say the sight of the word "cent," what will be the course of the generalization or the transfer of the conditioning to other words similar in meaning or in visual-auditory form? Will there be more transfer of conditioning to a word like "penny" than to a word like "scent" or will the reverse be true? A number of experimenters have established conditioned responses to verbal stimuli,[1] and most of them have noted transfer from conditioned sensory stimuli to their verbal correlates and *vice versa*.[2] But in no case was there any attempt to separate the semantic—or meaning-content—factor of the verbal conditioning from its mere visual-auditory form. It is clear, however, that such a separation lies well within the limits of the conditioning technique. By using, for instance, in the transfer tests one series

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[1] L. L. Madsen, C. M. McCay and L. A. Maynard, Cornell Univ. Agric. Exp. Sta. Memoir No. 178, 1935; L. L. Madsen, *Jour. Nutr.*, 11: 471, 1936.

[2] M. Goettsch and A. M. Pappenheimer, *Jour. Exp. Med.*, 24: 145, 1931.

[3] M. M. O. Barrie, *Nature*, 142: 799, 1938.

[4] M. Goettsch and J. Ritzman, *Jour. Nutr.*, 17: 371, 1939.

[5] C. G. Mackenzie and E. V. McCollum, SCIENCE, 89: 370, 1939.

[6] M. J. Cummings and H. A. Mattill, *Jour. Nutr.*, 3: 421, 1931.

[1] O. P. Kapustnik, in "Fundamental Mechanisms of Conditioned Reflex Activity in Children" (edited by A. G. Ivanov-Smolensky), Moscow-Leningrad, 1930, 11–22 (Russian); N. N. Traugott, E. P. Smolenskaya, N. N. Traugott and V. K. Fadeyava, L. E. Khozak, T. V. Kovsharova, L. I. Kotliarevsky, in "Studying the Highest Forms of the Neurodynamics of Children" (edited by A. G. Ivanov-Smolensky), Moscow, 1934, 273–450 (Russian); C. V. Hudgins, *Jour. Gen. Psychol.*, 8: 3–52, 1933; G. H. S. Razran, *Arch. Psychol.*, 28: 1–124, 1935; R. Menzies, *Jour. Psychol.*, 4: 75–120, 1937; K. Diren, *Jour. Psychol.*, 3: 291–308.

[2] Kapustnik, Traugott, Smolenskaya, Traugott and Fadeyeva, Khozak, Kovsharova, Kotliarevsky, Diren and Razran, *loc. cit.*

of words that are similar to the conditioned word in meaning but differ from it in verbal form and another series that are similar in form but differ in meaning, the conditioning values of the two factors may be readily compared and the amount of pure semantic—or meaning—conditioning easily determined.

A preliminary study of this rather significant problem was thus undertaken by the writer with the aid of a list of homophones and synonyms and with the use of salivation as the conditioning technique. Four simple words—*style, urn, freeze* and *surf*—were flashed on a screen at random order before three subjects who were chewing gum, sucking at lollipops or eating small tea-sandwiches. The subjects' individual eating periods lasted three minutes, in the course of which each word-to-be-conditioned was flashed fifteen times, and altogether five eating periods were made in each experimental session. After each eating period came an eight-minute testing period, during which the subjects' salivations to the exposed words were determined. The determinations were made by means of the writer's "cotton" technique that consists in ascertaining increments in weights of dental cotton rolls inserted under the subjects' tongue for periods of one minute. (With the use of proper control and rotation this technique is highly satisfactory and reliable.) The subjects were not aware of the attempts to condition them and were told that the purpose of the experiment was "to study the effect of eye-fatigue upon digestion." They became conditioned rather quickly, after two or three eating periods, but the tests with the transfer words were begun only on the second experimental session. The transfer words were: *stile, fashion; earn, vase; frieze, chill; serf, wave.*

TABLE 1

CONDITIONED SALIVATIONS OF 3 ADULT HUMAN SUBJECTS TO 4 WORDS, THAT HAVE BEEN FLASHED ON A SCREEN WHILE THE SUBJECTS WERE EATING, AND TO 4 HOMOPHONES AND 4 SYNONYMS OF THESE WORDS*

Words	Experimental session 2	3	4	5	Mean
Style	234mg.	276	293	218	255
Stile	57%	51%	43%	49%	50%
Fashion	64%	76%	66%	69%	69%
Urn	186	199	234	223	211
Earn	41%	34%	26%	34%	34%
Vase	50%	54%	48%	44%	49%
Freeze	268	308	314	246	284
Frieze	38%	32%	45%	46%	40%
Chill	43%	56%	68%	72%	60%
Surf	190	230	240	310	243
Serf	24%	20%	18%	28%	23%
Wave	46%	52%	68%	58%	56%
Mean for conditioned words	220	253	270	249	249
Mean for homophones	40%	34%	33%	39%	37%
Mean for synonyms ..	51%	60%	63%	61%	59%

* Each entry is a mean of 9 determinations and represents milligrams of net conditioned salivation (minus control salivation) in one-minute periods (the entries for the homophones and synonyms are given in percentages of the main conditioned salivation).

The results are presented in Table 1. The entries in this table are means of nine determinations, three for each of the three subjects. The entries for the conditioned words, or the words that have actually been associated with the eating, are given in milligrams of net conditioned salivation (minus control salivation) per one-minute periods. The entries for the transfer words are in percentages of salivation of the conditioned words. As seen from the table, by far the greater portion of the transfer conditioning went to the synonyms rather than to the homophones. The average transfer to the former was 59 per cent. and to the latter only 37 per cent., quite a pronounced difference. Furthermore, there was also some evidence that, as the conditioning progressed, the homophones lost some of their transfer and the synonyms gained. Again, while the amount of transfer for different synonyms varied considerably, ranging from 43 per cent. for *freeze-chill* in the first experimental session to 76 per cent. for *style-fashion* in the second experimental session, still in no case was the transfer for any homophone greater than that for its corresponding synonym. Within the limits of the present study the conclusion seems thus to be warranted that verbal conditioning is primarily semantic.[3] A subject gets more conditioned to the meaning of a word than to its mere visual-auditory form (although this pure form conditioning is, as seen from the table, by no means negligible). At any rate, the experiment provides an objective method for an experimental attack of a problem that heretofore could be discussed only in the light of subjective introspection or, at best, in the light of gross clinical observation.[4]

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THE GELATIN OF BROM PHENOL BLUE[1]

WHILE investigating the kinetics of the fading of brom phenol blue (tetrabromophenolsulfonphthalein) in dilute alkali, we[2] observed that the completely faded solution, on acidification, became progressively more viscous and in a few minutes set to a clear lemon-colored gel. Although gel formation is not an unusual phenomenon with high molecular weight solutes, the concentration sufficient to produce a stiff jelly is so low as to merit further study from those interested in the mechanism of gelation. Although only a few dyes of its series have been investigated, brom phenol blue appears to be unusual in forming a gel. Phenolphtha-

[3] The possibility that the conditioning to the synonym was only indirect, through first recalling the actual conditioned word, was ruled out by a "free association" test.

[4] Salivation is of course not the only suitable response for dealing with this problem. The galvanic skin response, the pupillary and wink reflexes and indeed any response that is readily conditioned and quantified should, as far as we know, be equally good.

[1] Contribution from the Chemistry Department, Columbia University.

[2] Amis and LaMer, *Jour. Am. Chem. Soc.*, 61: 905, 1939.

lein fades in alkali and can be regenerated by acidification but does not gel. The time of gelation after acidification is dependent upon the initial concentration of the dye (Table 1).

TABLE 1

Molar concentration of dye	Gelation time
1.0×10^{-2}	1 min.
4×10^{-3}	35 min.
1.7×10^{-3}	only viscous liquid

The fading process consists in a high dielectric solvent like water of the rate-determining addition of a univalent negative hydroxyl ion to the divalent negative ion of brom phenol blue forming a colorless carbinol. In solvents of dielectric constant less than 64.5, the kinetic process involves the univalent $(NaBr\phi B)^-$ ion. On acidification the colorless carbinol reacts with hydrogen ion forming the yellow acid form of brom phenol blue, since the addition of alkali sufficient to neutralize the acid added regenerates the characteristic blue color of the dye in intensity dependent upon the length of time lapsing after acidification. The kinetics of this process is being investigated.

It is suggested that the gel formation is dependent upon hydrogen bond formation. The gel gives evidence of being thixotropic. It is stable for only a few hours, after which time brown crystals, presumably the acid form of the dye, appear and grow steadily throughout the gel.

A solution 10^{-2} M in dye and 0.2 N in NaOH was not completely faded in 27 days. When heated to 60–70° for 20 minutes to hasten the fading we observed that the blue color of the original solution was regenerated. After 4 hours at room temperature the color faded, approximating that of the original on the 27th day. Gelation occurred both before and after heating.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PRACTICAL METHOD OF OBTAINING BACTERIA-FREE CULTURES OF TRICHOMONAS HOMINIS

Trichomonas hominis has been isolated in bacteria-free culture by using the following procedure: 6 mm Pyrex tubing 8 inches in length is plugged with cotton in each end, wrapped in paper and then sterilized by dry heat. The paper is removed from the sterile tube and, using a micro-burner, a capillary tube 16 inches long is drawn from one end of the tube. The distal tip is then broken off with a sterile forceps (great care must be exercised throughout the remainder of the procedure not to contaminate the terminal 4 inches of the capillary until it has been sealed). The tube is grasped in one hand and the proximal portion of the capillary tube in the other hand; then, by working on the edge of a very low flame, a series of loops or traps 3 or 4 mm in height are made as shown in the illustration.

Using a rubber tube (portion of an 18-F catheter) attached to a 10-cc syringe, the butt end is slid on the cotton-plugged end of the tube. Suction is then applied and the tube filled to within one inch of the top with sterile liquid medium. (Ringer 1 part, horse serum 8 parts.) Great care must be taken to see that no air bubbles are introduced into the capillary portion of the tube. The distal end of the capillary is sealed in a flame so that very little if any air is trapped in that portion of the tube. For stability and protection the capillary end of the tube is now slipped into a clear Cellophane envelope and the envelope fixed to the tube by adhesive tape. The tube is then incubated in a vertical position in a special rack (using pinch clothes pins for holders), for 48 hours and then observed for sterility. If no turbidity develops, for practical purposes it can be considered sterile. The liquid suspension of protozoa and bacteria is then carefully inoculated by layering into the top of the tube. The inoculated tubes are kept vertical and incubated at 37° C. From time to time the migration of the protozoa can be observed under the microscope by mounting the microscope on a platform so that the stage can be held in a 45 to 90° angle to the horizontal plane and using a mechanical stage prepared as illustrated. Trichomonas migrate slowly, and it usually takes 48

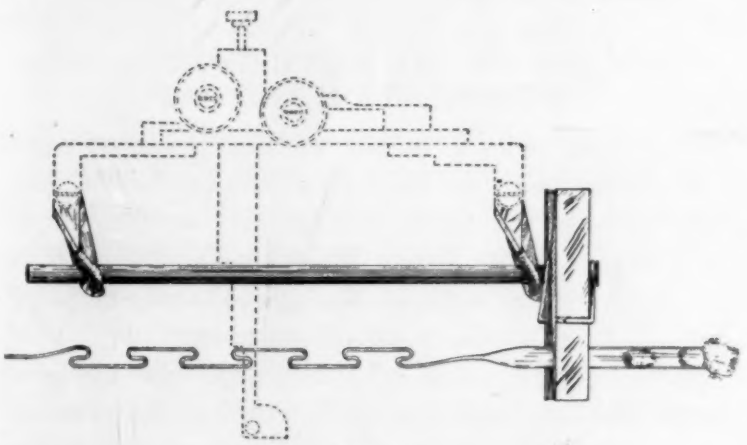

FIG. 1

hours or longer for the organisms to reach the bottom of the tube.

When the protozoa have reached the bottom of the tube the distal end of the capillary is cut off and sealed at the same time by applying a small flame to the area of the last trap. The severed sealed capillary is again observed for actively motile protozoa (usually many

present) and is then submerged in tr. iodine (7 per cent.) for one hour. At the end of this time the capillary is removed from the iodine by using a sterile forceps. The last sealed end is then carefully grasped by the fingers and the capillary held in a vertical position. The iodine drains toward the fingers, and when the outside of the tube is dry, segments from the distal end of the tube are broken off, with a sterile mosquito forceps, into selected culture media. *Trichomonas hominis* has been repeatedly isolated bacteria-free by using this technique.

Discussion

Our observations on the migration of motile protozoa seem to indicate that, with the exception of the free living phototactic organisms, their migration in liquid media is greatly influenced by the force of gravity. Very little progress is made against the force of gravity unless currents in the liquid support this movement. Currents in the liquid contents do not occur in capillary tubes, whose outside diameters do not exceed 0.8 mm. Migration of organisms in the liquid of the capillary apparently is influenced only by the motility of the organisms and the force of gravity, which result in gradual migration down the capillary. Motile bacterial organisms seem to be unable to make progress beyond the second trap and practically all of them are held back by the first trap.

The apparatus should be adaptable to the isolation of other actively motile flagellates and perhaps ciliates. However, we have not had the opportunity to test it using other organisms.

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THE USE OF THE HORSLEY-CLARKE INSTRUMENT ON THE RAT[1]

Since the reintroduction[2] of the Horsley-Clarke instrument[3] its use on the cat and monkey has become quite popular. A recent modification[4] has proved of considerable value. Lately it has been found possible to utilize the same instrument on albino rats by employing a few easily constructed special parts.

Ear plugs were dispensed with since the ear bars on the machine can be seated directly into the external auditory meatuses of the rat. Then, in order to center the animal, a c-shaped clamp is fastened to the ear bars. This makes it possible to loosen the screws holding the ear bars in position on the frame of the instrument and to move the animal back and forth, although the ear bars themselves remain rigidly seated in the rat's ears. A transverse bar and a light nose clamp were substituted for the usual mouth and eye clamps. After the ear bars are seated and the animal centered the nose-piece is adjusted so that the rat's long upper incisors rest just in front of the transverse bar. The nose clamp is then lowered. This centers and immobilizes the nose and holds the maxillae firmly against the transverse bar. No exact dimensions of these parts need be given, for they should be built so as to fit in the Horsley-Clarke machine with which they are to be used. Any machinist having the Horsley-Clarke instrument before him and with photographs of these parts which will be furnished on request should have no difficulty in making the special parts.

The operative procedures are quite simple. Under Evipal anesthesia (0.1 gm/kg. intraperitoneal) the hair is cut off the top of the head, the animal placed in the machine and an incision 1.5 to 2.0 cm long made through the skin in the midline. The electrode carrier is then set at the zero midsagittal plane and the electrode slowly lowered. If the tip of the electrode does not come to rest exactly upon the interparietal suture the animal is improperly placed in the machine and must be removed and replaced properly. The tip of the electrode is then raised and an opening in the skull made with the aid of a dental drill. Then the electrode is lowered to the desired point and the lesion made.

In working with rats it is very necessary that animals of uniform size and age be used. We have found it convenient to select animals weighing between 90 and 100 gms. If animals of more widely varying size are used little uniformity can be expected in the location of the lesions.

It would be desirable to produce chart sections of the rat's brain for the determination of coordinates of nuclei and fiber tracts, as has been done in the case of the cat and monkey. So far, however, such chart sections have not been made, since by the sacrifice of a few animals the location of any desired point in terms of the coordinates of the instrument can be determined by the method of trial and error.

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[1] From the Institute of Neurology, Northwestern University Medical School.

[2] S. W. Ranson, *Psychiat. en neurol. bl.*, 38: 534, 1934.

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